GAMMA-RAY INDUCED NEW RADIOACTIVITIES

BY

LUN HSIAO

B.A., National Tsing Hua University, China, 1939
M.S., University of Illinois, 1948

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN CHEMISTRY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1951

URBANA, ILLINOIS
1951

GAMMA-RAY INDUCED NEW RADIOACTIVITIES

BY

LUN HSIAO

B.A., National Tsing Hua University, China, 1939
M.S., University of Illinois, 1948

AN ABSTRACT OF A THESIS

SUBMITTED IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR THE DEGREE OF DOCTOR OF PHILOSOPHY IN CHEMISTRY
IN THE GRADUATE COLLEGE OF THE
UNIVERSITY OF ILLINOIS, 1951

URBANA, ILLINOIS

1951

ACKNOWLEDGEMENT

The author wishes to express sincerely his gratitude to Professor R. B. Duffield for his encouragement, patient guidance and personal participation in this work. He wishes to thank Professor R. A. Becker for allowing the author to use his internal probe tube in the betatron. He also wishes to acknowledge the able assistance of Mr. D. Riesen and his crews for running the 22 Mev betatron.

This work was assisted by the joint program of the ONR and AEC.

R. UNIV. BIBLIOTHEEK LEIDEN

GAMMA-RAY INDUCED NEW RADIOACTIVITIES

Introduction

The gamma-ray induced nuclear reactions are almost exclusively (γ,n) and (γ,p) with the 22 Mev betatron in the Physics Research Laboratory, University of Illinois. One of the problems in this laboratory has been to search for new radioactive isotopes produced by (γ,n) and (γ,p) reactions with the 22 Mev betatron. One advantage of this kind of searching for new radioactive isotopes by nuclear photodisintegration is that it furnishes the most convenient way to look for new radioactive isotopes which are hard to get by other nuclear reactions. The second advantage is the ease of assignment of elements by the relative yield of (γ,n) to (γ,p) when a chemical identification is not practicable. The third advantage is for making mass assignment. The photonuclear cross section changes only slowly and regularly with mass number so that the relative yield for any reaction can be predicted fairly accurately and the presence of small quantities of impurities will not produce any large quantities of extraneous activities. With the availability of the enriched stable isotopes from the United States Atomic Energy Commission the assignment of mass number is facilitated.

Experimental

Samples of enriched W^{186}, W^{184}, W^{180} and Cr^{54} obtained from the U.S. AEC were irradiated with x-ray from the 22 Mev betatron in order to study the radioactive nuclei W^{179}, W^{185m}, Ta^{185}, Ta^{183} and V^{53}. The activities so produced were chemically identified by appropriate chemical procedures whenever possible.

The activities were followed by a thin end window Geiger-Müller counter. β^- and β^+ were differentiated by a magnetic deflector. The energy of β^- particles was evaluated by the Feather analysis of the absorption curve in

aluminum. The energy of conversion electrons was estimated by use of a scintillation counter.

Summary Of Results

Four new radioactive isotopes, possibly a fifth one, have been produced by (γ,n) and (γ,p) reactions. Activities assigned to isomeric states of W^{179} by Ta^{181} (p,3n) by Wilkinson were comfirmed by W^{180} (γ,n) reaction. The disputed ~ 2 hour activity in Cr assigned to Cr^{53m} recently by Cadwell and Stoddart was not observed in Cr^{54} (γ,n). The results of this work are summarized in Table I.

TABLE I

Radioactive Nuclei Investigated

Isotope	Half Life	Type and Energy of Radiations (Mev)	Produced By
W^{179}	5.5 $\pm$ 0.2 minutes	K or I.T., e^-	W^{180} (γ,n)
W^{179}	30. $\pm$ 2. minutes	K, no e^-	W^{180} (γ,n)
W^{185m}	1.85 $\pm$ 0.15 minutes	e^-, 0.075	W^{186} (γ,n)
Ta^{185}	46. $\pm$ 2. minutes	β^-, 1.7	W^{186} (γ,p)
Ta^{183}	3.5 $\pm$ 0.2 days	β^-, 1.3 - 1.9 e^-, (?)	W^{184} (γ,p)
Ta^{183m} (?)	2-3 hours	e^-, (?)	W^{184} (γ,p)
V^{53}	21. $\pm$ 1. hours	β^-, 0.65	Cr^{54} (γ,p)

BIBLIOGRAPHY

1. Butement, F. D. S., Proc. Phys. Soc., A 64, 395 (1951)

2. Wilkinson, G., Phys. Rev., 80, 495 (1950)

3. Cadwell, D. O. and Stoddart, H. F., Phys. Rev., 81, 660 (1951)

VITA

Lun Hsiao was born in Pihsien, Szechwan, China on December 15, 1911. He received his B. of Chem. degree from the National Tsing Hua University, China in September 1939.

He entered the University of Illinois in September 1947 as a graduate student in Chemistry and received his M. S. degree in June 1948. He worked since as a half time teaching assistant in the Department of Chemistry of the University of Illinois.

He is a member of Sigma Xi and the honorary Chemical Society of Phi Lambda Upsilon.

He has published a part of the present work in Phys. Rev., 79, 1011 (1950).

Digitized by the Internet Archive
in 2026

https://archive.org/details/IA41549816_0213